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Methods and Costs of Killing Hardwood Culls

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A major management problem in hardwood forests is how to eliminate cull trees to make room for reproduction and to provide growing space for trees of better quality. Solving this problem will benefit the small woodland owners who want to practice good forestry as well as the managers of large commercial tracts.

Several methods of killing unwanted trees are being used but no method has been widely accepted. The various methods differ in cost as well as in effectiveness. To compare both the cost and effectiveness of four commonly used methods under similar conditions, we conducted a tree-killing study at the Kaskaskia Experimental Forest[1]. We found that treating low ax frills with 2,4,5-T was the most effective of the four methods used and, on the basis of diameter inches killed, it was also one of the cheapest.

[1]Results of the deep-notch ax girdle method were reported earlier by Greth *(2)*. Some of the results are included here for purposes of comparison.

METHODS

We treated more than 9,000 trees 4.6 inches d.b.h. and larger; about 85 percent were oak (*Quercus* spp.) or hickory (*Carya* spp.), 5 percent were blackgum (*Nyssa sylvatica* Marsh.), and 10 percent were other hardwoods. The four methods used were: (a) deep-notch ax girdle, (b) power-machine girdle, (c) 2,4,5-T in diesel oil, applied with a tree injector, and (d) low ax frill treated with 2,4,5-T in diesel oil.

The *deep-notch ax girdle* method consists of cutting a continuous notch around the tree with an ax (fig. 1). This was done just below waist height. Approximately 3,900 trees were treated in this way, about half of them during the growing season.

In the *power-machine girdle* method, the machine used was equipped with a flexible shaft and a circular cutting head. The girdles were cut at a convenient working height, usually just above waist level (fig. 2). A 2-man crew was used, each man taking alternate 30-minute shifts with the machine. The second man located the trees and cleared away obstructing brush and vines from around the tree bole with an ax. When fire scars or other callous tissue could not be cut completely through, the girdle was made above the scar (fig. 2). More than 800 trees were treated by this method during March, April, and May and about 1,000 were treated during late July and August.

FIGURE 1. — Ax girdling a blackgum tree.

FIGURE 2. — Power girdling around the callus of a butt-scarred black oak tree.

The *tree injection* method consists of injecting a herbicide inside the bark just above the groundline (fig. 3). The injector is a cylindrical container with a curved cutting blade and a device that releases a uniform amount of solution into the wound when the blade is jabbed into the tree. The injections were made around the base of the tree about 2 inches apart[2]. The herbicide used was low volatile amyl (pentyl) ester 2,4,5-T containing 4 pounds of acid per gallon. It was mixed with diesel oil at the rate of 1 gallon of 2,4,5-T to 10 gallons of oil to give a solution containing 40 pounds of acid equivalent per 100 gallons of oil. More than 2,200 trees were treated with the injector during March, April, and May.

The *low ax frill treated with 2,4,5-T* was done by one man using an ax and a 2-gallon spout can containing herbicide. A continuous, single-hack frill was made around the tree at stump height or lower, depending on the presence of butt swell or butt scars (figs. 4*A* and 4*B*), and the frill was saturated with herbicide. A 3-inch piece of ¼-inch-diameter copper tubing was soldered to the spout of the can to aid in controlling the rate of herbicide flow. The same type of 2,4,5-T was used as with the injector but at a concentration of 20 pounds a.h.g. More than 1,500 trees were treated by this method during April and May.

[2]According to the printed instructions of the manufacturer for "easy to kill" species, including white and post oak.

FIGURE 3. — The tree injector in use.

FIGURE 4. — (A) Applying 2,4,5-T solution to a low ax frill, (B) Making a low ax frill on a tree that has an open butt scar.

RESULTS

The *low ax frill treated with 2,4,5-T* was the most effective method (table 1). Two years after treatment 98 percent of all treated trees were dead. One percent had one or two small, unthrifty sprouts per tree, and the other one percent had live crowns. This treatment was about equally effective for all trees regardless of size or species (tables 2 and 3). Cost of treating 1,000 diameter inches of trees was $11.10 and, because nearly all treated trees were killed, the cost of killing 1,000 diameter inches was almost the same: $11.44 (table 4).

The *deep-notch ax girdle* killed 69 percent of the trees treated during the growing season and 62 percent of those treated during the dormant season (table 1). Ax girdling was most effective for white oak (*Q. alba* L.) and least effective for blackgum (table 2). Moreover, this method was more effective for large trees than for pole-size trees (table 3). Cost of treating 1,000 diameter inches of trees was $9.95. However, cost per 1,000 diameter inches of trees killed was $16.05 for the dormant-season treatment, and $14.42 for the growing-season treatment.

The *power-machine girdle* was more effective when done in the spring than when done during mid-summer. The spring treatment killed 73 percent of the trees, and the mid-summer treatment killed only 44 percent (table 1). As with ax girdling, this method was most effective for the white and post (*Q. stellata* Wangenh.) oaks and least effective for blackgum (table 2). By this method 55 percent of the 5- to 7-inch trees were killed, and 67 percent of the trees 18 inches and larger were killed (table 3). Machine girdling during the spring was cheaper and more effective than during mid-summer, so the cost of killing 1,000 diameter inches of trees in the spring was much less than in summer — $9.70 compared with $21.36.

The *tree-injection method* killed only 34 percent of the treated trees (table 1). It was most effective for post oak and least effective for blackgum (table 2). Cost of treating 1,000 diameter inches of trees was only $5.88, but the cost of killing 1,000 diameter inches of trees was $18.38.

The dollar rates used in table 4 may not fit all conditions. Therefore, the actual man-hours, equipment-hours, and materials required per 1,000 diameter inches are given (table 5). This information will allow a direct comparison of the methods under different conditions.

Table 1. — *Effectiveness of four methods of killing trees 2 to 3 years after treatment*
(In percent of treated trees)

Treatment	Season	Tree condition			
		Dead	Dead tops but sprouted	Live crowns	Total
Ax girdle	Dormant	62	35	3	100
	Growing	69	28	3	100
Machine girdle	Early spring	73	12	15	100
	Mid-summer	44	19	37	100
Injector with 2,4,5-T	Early spring	34	3	62	100
Low ax frill with 2,4,5-T	Early spring	98	1	1	100

Table 2. — *Trees killed by species, method, and season*
(In percent of treated trees)

Treatment	Season	Species					
		Hickory	White oak	Black and red oaks	Post oak	Blackgum	Other species
Ax girdle	Dormant	56	78	60	1/	33	60
	Growing	76	85	63	1/	51	63
Machine girdle	Early spring	72	77	76	82	15	76
	Mid-summer	36	55	55	46	10	24
Injector with 2,4,5-T	Early spring	32	27	28	61	22	39
Low ax frill with 2,4,5-T	Early spring	98	99	96	100	96	92

1/ Included with "other species"; mostly hard maple, beech, and blackjack oak.

Table 3. — *Trees completely killed by diameter class and method*
(In percent of treated trees)

Treatment	Tree-diameter class (inches)			
	5-7	8-10	11-17	18+
Ax girdle	51	62	73	87
Machine girdle	55	57	58	67
Injector with 2,4,5-T	44	27	21	24
Low ax frill with 2,4,5-T	98	98	95	86

Table 4. — *Cost comparison[1] of four methods of killing 1,000 diameter inches of cull trees*
(In dollars)

Method	Cost per 1,000 diameter inches	
	Treated	Killed
Ax notch girdle		
Dormant season	9.95	16.05
Growing season	9.95	14.42
Power-machine girdle		
Early spring	7.18	9.70
Mid-summer	9.40	21.36
Injector with 2,4,5-T	5.88	18.38
Low ax frill with 2,4,5-T	11.10	11.44

1/ Based on:

Labor	$1.20 per hour	(Wages)
Machine girdler	.75 " "	(Operation & depreciation)
Injector	.05 " "	(Depreciation)
Ax	.02 " "	(Depreciation)
2,4,5-T concentrate	7.00 " gal.	(Cost)
Diesel oil	.14 " "	(Cost)

NOTE: Cost of marking trees for treatment was not included because it was the same for all methods.

Table 5. — *Labor and materials required to treat 1,000 diameter inches of cull trees*

Method	Labor	Remarks
	Man-hours	
Ax notch girdle	8.16[1]	
Power-machine girdle		
Early spring		
Girdling	3.80	1.90 machine-hours 1.90 ax-hours
Bit sharpening	.96	
Mid-summer		
Girdling	5.93	2.96 machine-hours 2.96 ax-hours
Injector with 2,4,5-T	3.74	1.63 gallons solution[2] 3.03 injector-hours
Low ax frill with 2,4,5-T	7.08	5.25 gallons solution[3] 6.55 ax-hours

1/ Based on formula developed from ax girdle data (4).

2/ Forty pounds a.h.g. concentration of 2,4,5-T and diesel mixture.

3/ Twenty pounds a.h.g. concentration of 2,4,5-T and diesel mixture.

FIGURE 5.—Cross section of a tree that lived and continued to grow after treatment with the tree injector. Note lack of lateral translocation.

DISCUSSION

The big difference between cost per 1,000 diameter inches of trees killed by power-machine girdling in the spring and in the summer is chiefly due to the higher percentage of trees killed by the spring treatment. This is probably because the cutter heads were sharpened more often during the spring treatment than during the summer treatment. Using sharp bits all the time gave a cleaner and deeper notch with less effort. This did not greatly affect sprouting but apparently did kill more trees.

The relatively low percentage of kill with the tree injector probably was due to the wide spacing of the injections (figs. 3 and 5). There was no lateral translocation of the herbicide and the injections merely killed strips of tissue up the tree (fig. 6). Stephenson and Gibbs (*5*)[3] in a later study found that the injector wounds must be closely spaced or preferably overlapped to be effective. They also reported finding little or no lateral translocation. [4]

Our injector treatment was done during the late dormant and early growing seasons. Brinkman (*1*) concluded from a Missouri study that early spring is the best time of the year to get root-kill with 2,4,5-T. Also, the 2,4,5-T concentration of 40 pounds a.h.g. was recommended by the injector manufacturer and was twice the concentration used in the ax frills. We do not know whether it would be cheaper to use the injector and make a *complete* frill or to use the ax for this purpose.

The effectiveness of the 2,4,5-T in a low ax frill depends on careful application. On bottomland areas, where sprouting is profuse, 2,4,5-T in a *complete* frill killed nearly 100 percent of the treated trees (*3*); but if even a single gap was left in the frill, the tree lived.

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[3]Numbers in parentheses refer to Literature Cited, page 9.

[4]Light-weight tree injectors with improved solution-release devices have recently been placed on the market. These light-weight injectors offer promise as a method of treating the whole circumference of a tree.

FIGURE 6. — A white oak tree that had been treated with the injector. The injections killed narrow strips of tissue up the tree.

CONCLUSIONS

The four methods studied differed in effectiveness for trees of different sizes. The methods using 2,4,5-T killed small trees a little more readily than large trees, while the mechanical methods were definitely more effective on the large trees than on the small ones. This difference is due to the near absence of sprouting by the larger trees. The herbicide in low ax frills was a highly effective killer even of the largest trees and effectively controlled sprouting on trees of all sizes.

The low ax frill with 2,4,5-T (20 pounds a.h.g.) can be used where a 100 percent top and root kill is desired and where immediate silvicultural benefits are important. This method is especially advantageous to owners of small woodlands with few trees to kill because of the relatively low cost, simplicity of equipment, and ease of doing the job. If a complete killing job is required, mechanical girdling alone should not be used except on sawtimber-sized trees of easy-to-kill species.

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